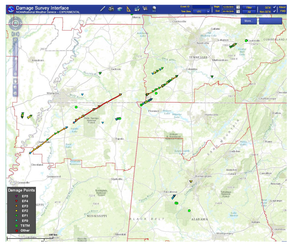
Using Satellite Remote Sensing to Assist the National Weather Service (NWS) in Storm Damage Surveys

Lori A Schultz[1], Andrew Molthan[2], Kevin McGrath[3], Jordan Bell[1], Tony Cole[1], Jason Burks[4]
[1]Earth System Science Center, University of Alabama in Huntsville, Huntsville, AL, [2]NASA MSFC, Huntsville, AL, [3]Jacobs ESSSA Group, [4]MDL/CIRA

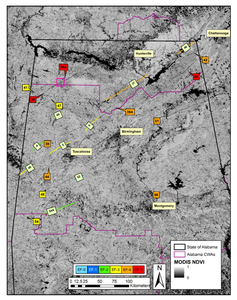
American Geophysical Union Annual Meeting, 14 December 2016, IN33B-1817

Project Background



In the United States, the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) is charged with performing damage assessments when storm or tornado damage is suspected after a severe weather event. This has led to the development of the Damage Assessment Toolkit (DAT), an application for smartphones, tablets and web browsers that allows for the collection, geolocation, and aggregation of various damage indicators collected during storm surveys.

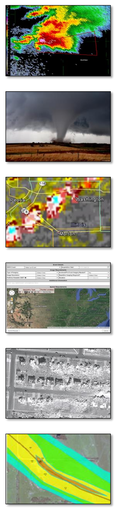
Project Motivation



- NASA SPoRT provided MODIS and ASTER imagery to WFOs in Alabama to support April 27th, 2011 damage assessments across the state
- SPoRT was awarded a NASA Applied Science: Disasters Feasibility award to investigate the applicability of including remote sensing imagery and derived products into the NOAA/NWS Damage Assessment Toolkit (DAT)
- Proposal team was awarded the 3 year proposal to implement a web mapping service and associate data feeds from the USGS to provide satellite imagery and derived products directly to the NWS thru the DAT.

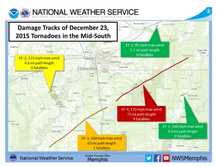
Timeline and Usage

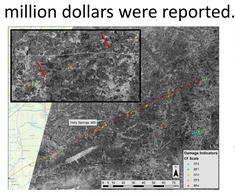
If severe weather is forecasted for an area, the workflow that is most often followed is as follows:

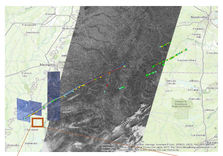


Severe Weather Event on 23 December 2015

A strong system with record warm temperatures along with impressive upper level wind fields provided the ingredients to produce five tornadoes across the Mid-South on December 23, 2015, including two long tracked violent tornadoes, killing eleven people. Fourteen deaths in and over 100 injuries nationwide were attributed to the storm system and an estimated property loss of over $16 million dollars were reported.

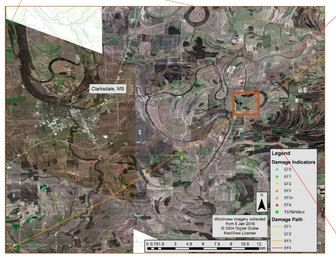


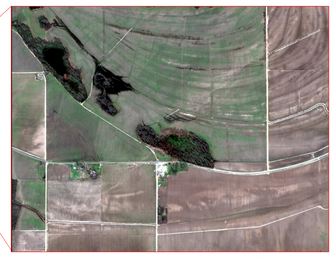




National Weather Service forecasters from the Memphis office were deployed to conduct surveys early on the 24th using the Damage Assessment Toolkit (DAT) application installed on mobile devices.

The Landsat 8 instrument passed overhead on the afternoon of the 24th, providing the forecasters a first look of the damage from satellite. Additional data from DigitalGlobe's WorldView-3 satellite became available through a partnership with the U.S. Geological Survey (USGS) Hazard Data Distribution System (HDDS: http://hddsexplorer.usgs.gov/) in early to mid-January.

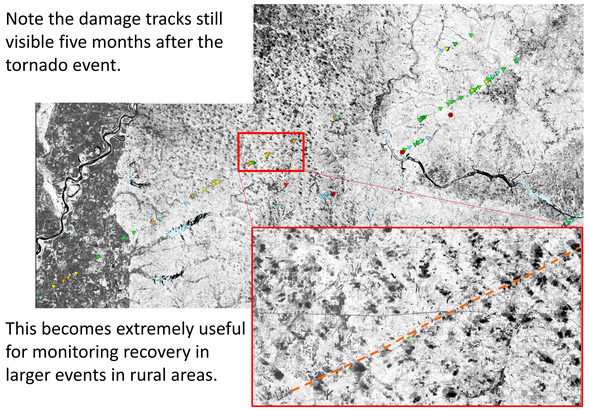




As shown to the left, the provided WorldView imagery was located to the far western portion of the first EF-3 track. Scarring was visible in the open fields. Similar high-resolution imagery was not available over the EF-4 track to the east.

Sentinel-2 MSI imagery was not available in near real-time (NRT) during the event. Using data acquired from the USGS Earth Explorer portal, all available imagery was acquired from December to June. (December through March was too cloudy to be used for analysis.) Shown here is the NDVI product for the May 5th and 13th passes over North Mississippi, North Alabama and southern Tennessee.

Note the damage tracks still visible five months after the tornado event.



This becomes extremely useful for monitoring recovery in larger events in rural areas.

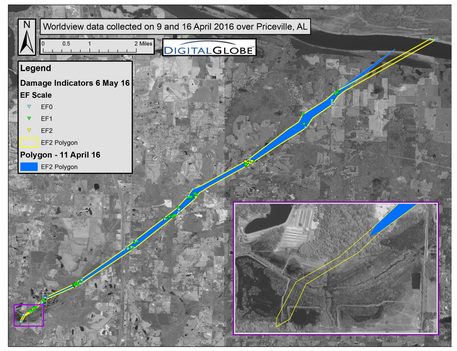
As Sentinel – 2 MSI datasets flow in NRT, the addition of derived products and RGBs can greatly increase the availability of satellite data to the NWS personnel in support of damage surveys. Data such as these has been used to confirm/change track start and end points, determine width, as well as identify tracks missed by the ground survey team due to limited access or terrain considerations.

The increased temporal resolution provided by the use of Landsat and Sentinel derived products together greatly impacts track detection and analysis, especially when commercial imagery is unavailable.

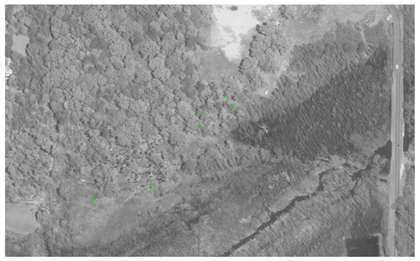
Severe Weather Event on 31 March 2016

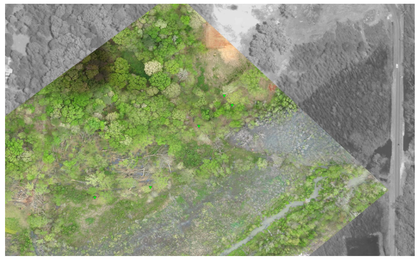
Severe weather hit the Tennessee Valley in early March. EF-2 Tornado In Priceville, AL. NWS personnel surveyd areas affected the next day, but had indications that more damage may be in the very rural areas

Landsat 8 imagery was available, but cloud cover, complicated use. Worldview imagery was received on 9 April 2016 that covered the southeastern portion of the damaged area, where tree damage was reported. Additional imagery was available on the 16th and 17th.



The imagery prompted the NWS personnel to revisit the area (located over 2hours away from the office) to confirm the additional damage and extend the track

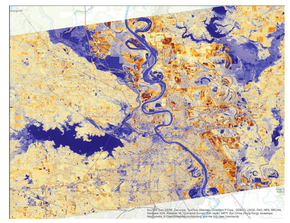




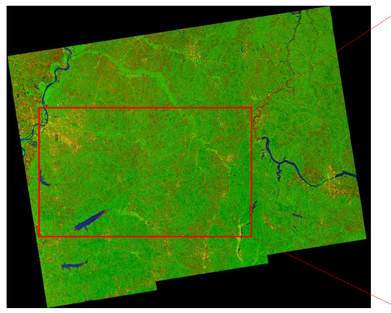
Multiple Flooding Events in Louisiana, 2016

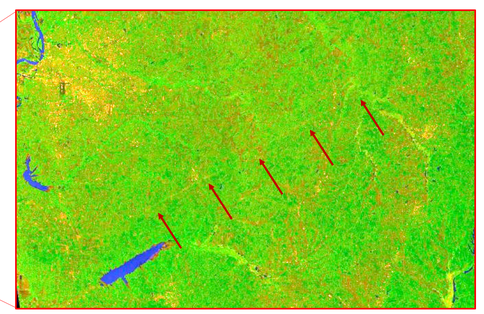
The state of Louisiana has suffered through multiple large-impact flooding events during 2016. Working with the National Weather Service and the Federal Emergency Management Agency (FEMA) at both the regional and national level, products are being explored to help first responders and other response agencies locate, monitor and respond to flooding events

In the top figures (right), Digital Globe WorldView multi-spectral imagery was used to compute a true color RGB and NDWI during the March flooding event. Imagery from 13 March 2016.
In lower images, WorldView multi-spectral imagery from 16 August 2016 was used to produce a true color RGB as well as a RGB that takes advantage of the near-infrared band and the two red bands to help delineate land from water.



Severe Weather Event on 23 December 2015 … Revisited





https://vertex.daac.asf.alaska.edu/

Image Credits and Copyrights

Landsat:
USGS/NASA Landsat Program
Data available from the U.S. Geological Survey. Questions concerning the use or redistribution of USGS data should be directed to: ask@usgs.gov or 1-888-ASK-USGS

Worldview Imagery:
© 2004 Digital Globe
NextView License
DIGITALGLOBE

Contact information: Lori.Schultz@nsstc.uah.edu.

For more information, please visit: http://weather.msfc.nasa.gov/sport/disasters/